

10/07/18
9:25 am

Mining Machinery.

2017

- ① What is conveyor? Write its advantages and disadvantages.

Ans Conveyor

A conveyor is basically an endless belt in a straight line stretched between two drums, one driving the system and the other acting as a return drum.

It is employed to convey a great variety of bulk materials along a horizontal or gently inclined paths (roads). It is used mechanize material handling operation. It is used for carrying Coal, ores and minerals in power plants, mining industries etc.

⇒ Components (Parts) of a Conveyor

The system of transport by belt conveyor consists of the following -

- (1) A flat endless belt which continuously travels and carries on its top surface the materials to be conveyed.

- (2) Idlers which support the belt.
- (3) The structure of angle iron or channel iron on which idlers are mounted.
- (4) The tensioning arrangement to keep the belt in proper tension.
- (5) Main and tail drum.
- (6) The drive head comprising the electric motor, coupling, gearing & snub pulleys.

→ Advantages

- (i) Noiseless operation
- (ii) Large length of conveying path.
- (iii) Lower power consumption.
- (iv) Long life.
- (v) Adaptability to different types of goods.
- (vi) Ability to carry almost any bulk material.
- (vii) High reliability of operation.
- (viii) Can transport material in any direction.

→ Disadvantages

- (i) Accumulation is difficult.
- (ii) Complicated marshalling.
- (iii) The loss of light weight bulk material carried away as dust or spilled from the belt along its path is another objectional feature.
- (iv) Continuous or periodic monitoring of belt is necessary.
- (v) Heat affects the material of belt.

Ques

1 (a) What are the factors on which recommendation of Conveyor system depends?

Ans- There are no. of factors that must be taken into account when selecting the Conveyor system -

- (i) Fire resistance or anti-static properties.
- (ii) Resistance to oils or chemicals.
- (iii) Temperature of the operating environment or conveyed material.
- (iv) Resistance to ageing, weathering and ozone.

- (v) The type of material being conveyed.
- (vi) The lump size and shape of the material being conveyed.
- (vii) The mix of lumps and fines in the material.
- (viii) The abrasiveness of the material.
- (ix) The method of loading the belt.
- (x) The fall height of material to the belt.
- (xi) The cycle time of the conveyor for a single revolution of the belt.
- (xii) Performance or experience in a similar application.
- (xiii) For replacement belts — the performance of previous belts on the same installation.
- (xiv) Availability
- (xv) Cost.

② Give a brief account of different method of transportation system used in U/g mines.

OR

Describe rope haulage. Write its advantages and disadvantages.

OR

Describe an endless haulage system. Explain how tubs are attached to the rope? (clip, lashing chain)

OR

Give a brief account of different types of rope haulage system used in U/g mines.

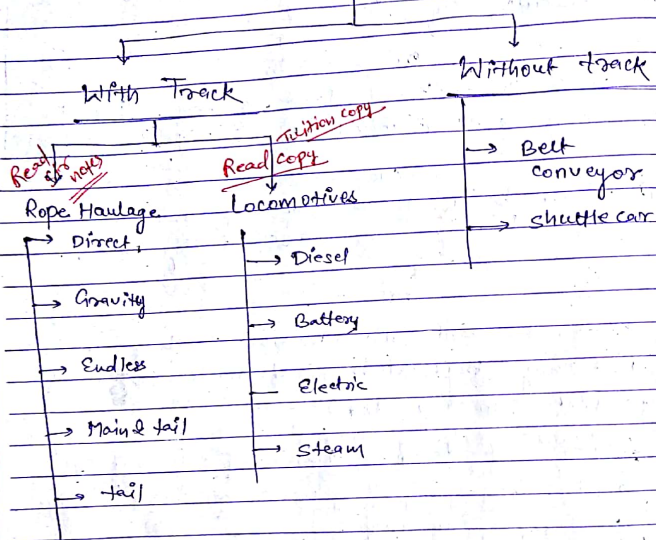
OR

Sketch and describe various safety devices that may be used on self acting incline to prevent runaway OR

Sketch and describe some of the safety devices that may be used on rope haulage to prevent runaway.

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Ans Method of Transportation System used in u/g mines



→ Transportation

There are three activities in mining industries which are -

01. Production of mineral
02. Transport of men / material
03. Maintenance of system.

Transportation is the most important activities by which the mines are transported from u/g to surface and surface to u/g.

① Rope Haulage

The main roads feeding the shaft must supply a continuous stream of coal throughout the working shift. The Rope haulage can be successfully applied as main haulage or secondary haulage or gathering haulage in both u/g and BOP method of working. Rope haulage is applicable to all existing installations and specially where the roadways are driven in a seam of varying gradient or in shallow mines, where coal has to be hauled up an incline drift to the surface.

The empty tubs attached to the end of the haulage rope travel on the down gradient by their own weight and do not require power from the engine (motor).

They are of 5 types -

- (i) Direct
- (ii) Endless
- (iii) Main & tail
- (iv) Gravity
- (v) Tail.

(2) Locomotive Haulage (Transport)

The locomotive haulage is most efficient and simplest method of u/g transport especially in mines where the reserves of coal in a given area is large enough to justify the huge capital expenditure involved. The essential requirement of this system is that the roadways are approximately level and this limits its application either to mines developed on the horizon system where roadways are driven level or at gradient of 1 in 200 or so.

They are of 4 types

- (i) Diesel
- (ii) Battery
- (iii) Trolley wire (Electric)
- (iv) Steam

(3) Conveyor haulage

These are being used to an ever (एक) increasing extent in modern haulage system. The use of the cable belt or reinforced belt have allowed longer haulage and high lift to be economically tackled. The nylon cord belt has been of immense improvement. It has allowed increased length of haul and reduced belt costs. It has allowed belts to operate with smaller diameter pulleys ^{deep} ~~deep~~ throughing is also possible.

These are of following types -

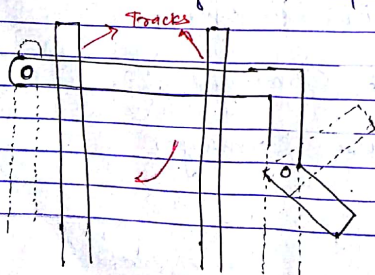
- (i) Chain Conveyor
- (ii) Belt Conveyor
- (iii) Shaker Conveyor

→ Various Safety devices used on rope haulage system

- (i) Stop block
- (ii) Buffer
- (iii) Back stay (Drag)
- (iv) Monkey catch
- (v) Runaway switch
- (vi) Drop Warwick
- (vii) Jazz rail
- (viii) Lever

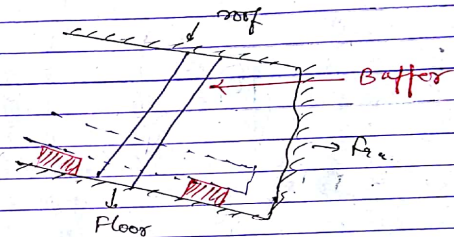
① Stop block

Stop block is used at the top of the incline to capture (arrest) the tubs when running away takes place due to any reason. Stop block is a wooden or iron beam placed across the track. It is pivoted at its one end & held against the pivot end. The other end is placed on a block at the another side of the track.



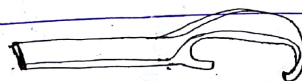
② Buffer

When any roadway or face is in direct line with a haulage track and persons may be exposed to danger from runaway tubs, strong buffer is provided and maintained on haulage road to prevent such danger. Buffer may be horizontal or vertical.



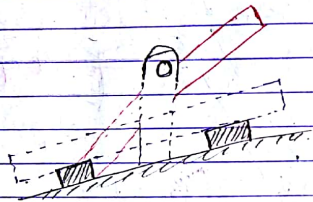
③ Back stay (Drag)

It is made of iron & its length is 80 cm. Its end is formed as hook and another end is formed sharp like tail of fish. Its width is about 15 cm. It is attached to the axle of last tubs of the train. When runaway of tubs takes place. It stop against the sleeper of track & arrest the movement of tub. This device mainly use in direct haulage.



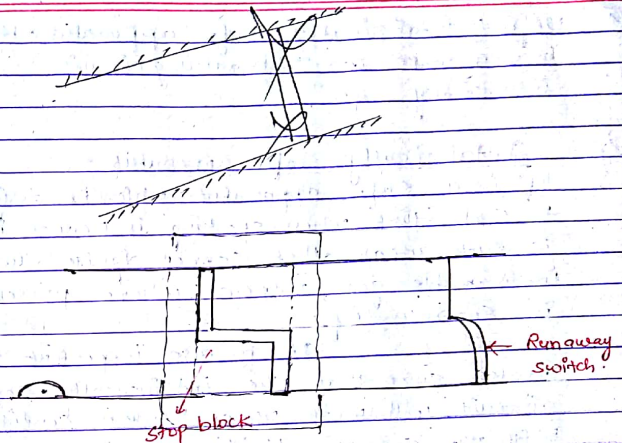
④ Monkey Catch

It is a small piece of steel rail which is pivoted & placed b/w the track by proper arrangement. It catch the axle of the backward running tubs. Sometimes a wooden block pivot at one end & pressed over the rail or track by a spring. This is normally used in endless haulage.



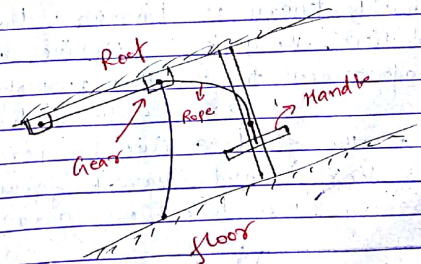
⑤ Runaway switch

It is a type of shunt which provides a second line of defence. When conventional device failed. This is fitted. This is fitted in combination with stop block. The distance b/w stop block & runaway switch is equal to the sum of the length of train + lorry. This is operated by a haulage attendant.



⑥ Drop Warrwick

This is a device used to arrest the forward running of tubs. It is installed generally below the incline mouth. It is also installed near the bottom & below the intermediate level.



④ Define intrinsically safe apparatus. How do you make an apparatus / circuit intrinsically safe?

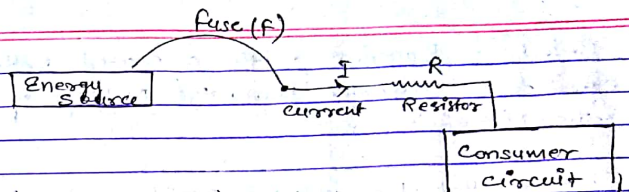
Ans - Intrinsically safe apparatus -

It is a safe apparatus which is designed to such that when sparking is occurs it is such weak that cannot ignite the inflammable gas, vapour where present in surrounding.

It is also important to make sure that the intrinsically safe circuit will work under normal conditions. With the current limiting resistance resistor, a voltage drop will occur between the input and output of the barrier.

To protect the intrinsically safe apparatus in a hazardous area, an energy limiting device must be installed. It is commonly known as barrier. Under normal condition, the device is passive and allows the apparatus to function properly.

Under fault conditions it protects the field circuit by preventing excess voltage and current from reaching the hazardous area.



Fuse and Resistor is used as current limiting resistor.

⇒ Following are the steps to make an circuit intrinsically safe -

- (i) Determine if the field device is a simple or non-simple (energy storing) device that needs approval and has entity parameters.
- (ii) Select the type of barrier needed to protect the individual v/g lines of the circuit.
- (iii) Normally, temp. sensors are used as AC barrier. For Analog inputs and current source sourcing switching, use the supply and return barrier. The remainder (analog and digital) outputs and some switching circuits) require DC barriers.

(iv) Select a barrier with a rated voltage equal to or greater than the voltage of the circuit.

(v) Confirm that the internal resistance of the barrier will allow enough voltage for the field device to operate properly.

(vi) Confirm that the entry parameters of the barrier match those of the field device.

- ⑥ How two armoured cables are joined? Describe the cable joint box with neat sketch. To be a perfect joint, what conditions must be fulfilled.

OR

Describe straight through joint box with neat sketch.

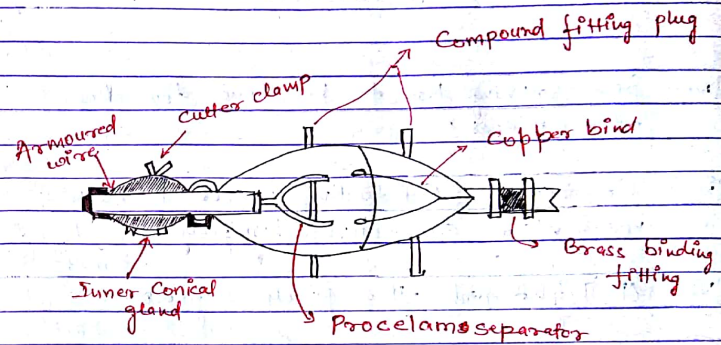
Cable joint box

When the two lengths of cable have to be joined must be made through the medium of a metal box which is called "Joint box". The joint box is made of cast iron & splitted longitudinally to give access to the conductors of the cable and assembled after the work of joining, the cable is finished.

The essential features of the joint box are as follows -

- (i) It must effectively protect the conductor from the injury.
- (ii) It must preserve the efficiency & continuity of the insulation & exclude moisture

- (iv) It must secure the cable armour & bound it in such a way as to maintain the continuity of earthing system.

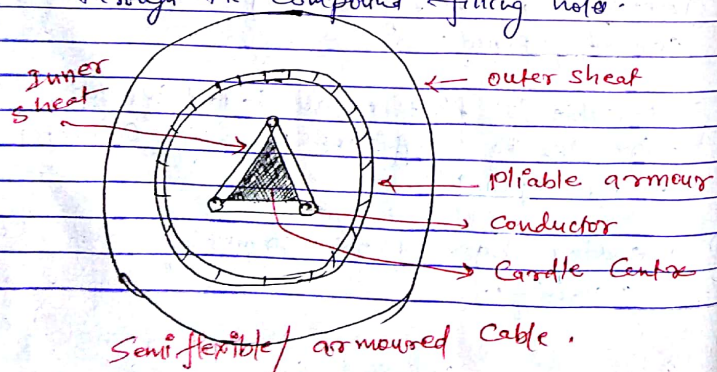


→ Straight through joint box

System of connection to joint box

- (i) Joint box is made of two pieces which can be opened.
- (ii) The cable is first of all bound by soft wire leaving sufficient length for connection in the open side.
- (iii) Bending back of the armouring and clamping.

- (iv) Push the inner clamp up to the end of turning the armouring.
- (v) Open up the insulation of the conducting wires.
- (vi) Same thing has to be done for the other pieces.
- (vii) Connect the conducting wires through mechanical connectors properly.
- (viii) Tightened the pinch screws.
- (ix) Put the Cover of joint box.
- (x) Tightened the clamps in the inner clamp.
- (xi) Pour Compound Inside the joint box through the Compound filling hole.



⇒ To be a perfect joint, the joint box must satisfy the following conditions—

- (i) It must be effectively protect the conductors from injury.
- (ii) Must maintain efficiency and continuity of the power core.
- (iii) Continuity of the earthing system.
- (iv) Prevent moisture to enter.
- (v) Rough and tough enough for mining conditions.
- (vi) Must secure the cable armouring and bonding in such a way that it remains continuous.

Q ⑥ What is the function of Gate end box? With suitable circuit diagram explain how different protection works.

OR

Q. What is the function of Gate end box? Draw circuit diagram for earth continuity protection incorporated with this.

GATE-END-BOX

This is a flame proof box (enclosure) containing electrical gadgets for supply of power to the face machinery in the district.

This is kept at the entrance of the district i.e. the gate of the district. The place should be in fresh air where there is no gas or dust pollution.

The gate end box receives power to a single wire armoured cable from the pit bottom. This facilitates the connection of a trailing cable to the face machine.

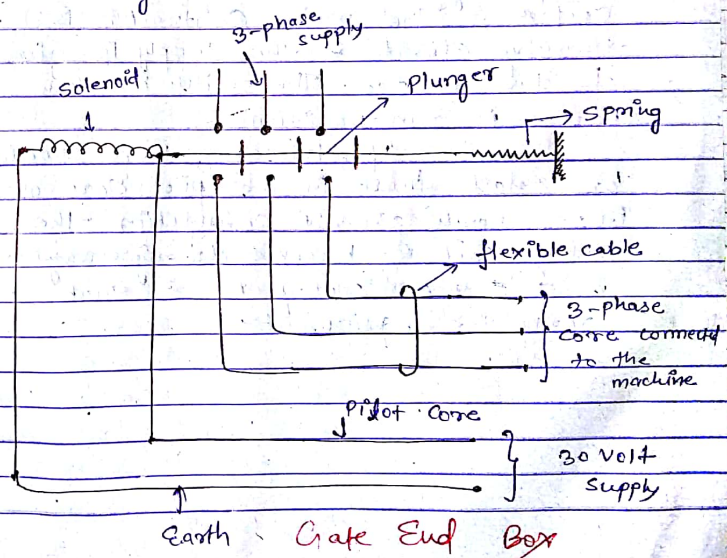
⇒ Function of Gate End box

The function of the gate end box is for supplying powers to a part of a mine. The high voltage supply is brought in by a transformer substation.

The main road cable then transmitting current in by a at pressure. The inbye substation will contain -

- Incoming high tension switch panel.
- 3300/550 Volt step down transformer.
- 550 Volt switch gear for the outgoing feeders.

From this point at medium pressure is taken in by to the gate and switch gear which controls the face machinery.

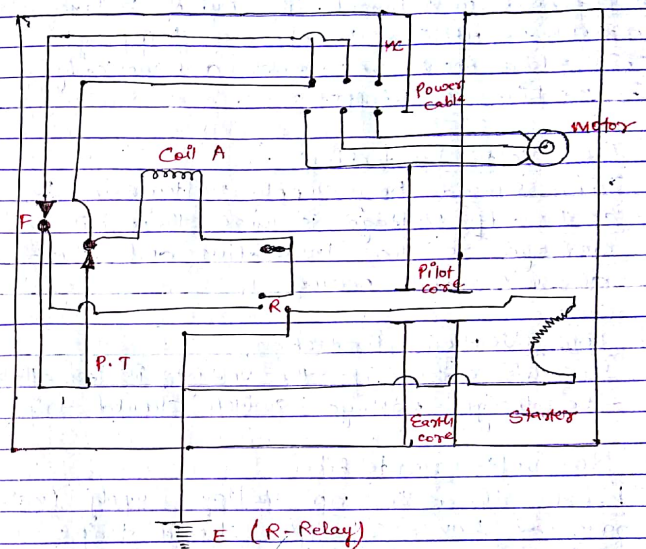


⇒ Different circuits for protection

(1) Earth continuity protection circuit

There is a circuit through the pilot core, motor switch, Earth core, the secondary side of potential transformer (P.T.) & the Relay coil 'R'. The transformer is protected by fuse 'F' on the High tension side. When the motor switch is placed in Start position relay coil 'R' is energised. So closing the relay & completing of circuit coil 'A'. The main Contractor is thereby closed & the supply is given to the motor. The switch is then placed in run position.

If, however, there should be small fault in the pilot core or in the earth circuit connection the relay coil R become de-energised & this opens relay R & shut down the equipment.



(2) Leakage Protection

The essential feature underlying the action of an automatic leakage protection device is that, in a normally healthy 3 phase power circuit, there is a balance of current in 3-phase. If the circuit, whereby ~~there~~ there is a leakage of current to the earth or b/w the phases. The current balance is upset.

and becomes unbalanced. The out of balance current is utilised to operate tripping coil which opens the switch automatically & machine is stopped.

(3) Over Volt Protection

There should be supply voltage as per design. If voltage is more there will be damage to the insulation and short circuit will occur.

(4) Low Voltage Protection

In this case if the voltage is less than the design voltage switch should trip.

(5) No Volt protection

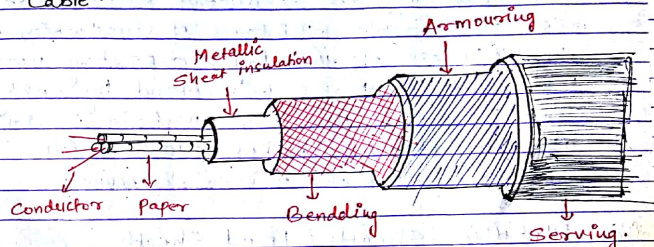
When there is no voltage supply in the gate end box, switch should trip.

This will protect the whole system against sudden supply of supply of current.

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Q. 5(a) State the Construction of PILSDWA Cable.

Ans



A PILSDWA Cable consists of the following

(1) Conductors

A cable may have one or more than one conductors depending upon the type of service for which it is intended. Three conductors for three (3) phases. It is made of fine tinned standard copper or Aluminium of high capacity.

The conductor size should be such that the cable carries desired load current without over heating and causes voltage drop within the permissible limit.

(2) Insulation

Each core of the conductors are provided with a suitable thickness of insulation. The thickness of the layer depending upon the voltage to be withstand by cable. They commonly use for material insulation are impregnated paper, Varnish Cambric rubber minner compound.

(3) Metallic Sheath / Lead Sheath

In order to protect the cable from the moisture, gases or other acid in soil or atmosphere, a metallic sheath of aluminium is provided to cover the insulation. In order to high degree of safety and reliability at the voltage formed which it is designed.

(4) Bedding

Over the metallic sheath is applied a large of bedding which consist of a fibrous materials like jute. The purpose of bedding is to protect the metallic sheath against corrosion and from mechanical injury due to armoring.

(5) Armouring

Over the metallic sheath is applied a layer of bedding which consist of one or two layer of galvanised steel, wire or steel tape, its purpose to protect the cable from mechanical injury while laying it and during course of handling.

(6) Servicing

In order to protect the armoring a layer of bedding of vulcanized rubber is provided. It gives mechanical strength.

Winding

(2) What are the criteria for selection of guide ropes?

Ans. A wire rope is to be selected on the following considerations -

(1) Watery place and Corrosive atmosphere
A galvanised rope should be used to prevent rusting and effect of corrosive fumes.

(2) High temperature
Rope with fibre core should be avoided.

(3) Stationary or running coil type
Stationary ropes can be of large diameter or stands eg - guide ropes in shaft.

Running ropes requires flexibility and smaller diameter - eg. rope used in C.M.

(4) Spinning or rotating quality
In a sinking shaft, the sinking bucket is not travelling on guides. Therefore a non-spinning rope of locked coil construction or a rope with ordinary lay be used.

(5) Shock loads

Where a rope has to withstand shock loads, the core should be of steel.

(6) Resistance to wear

Ropes of haulage and winders have to be flexible and resistance to abrasive wear.

Such rope should be of lang's lay construction as they offer more wearing surface.

(7) Tensile strength and factor of safety
Rope used for winding of men should have high tensile strength and factor of safety not less than 10.

(8) Bending fatigue

Repeated bending of rope causes fatigue which causes failure of wire. The rope should be flexible.

(9) Groove size

The rope should not be loose or too tight in the groove of the pulley or drum.

(10) Crushing and distortion

A flattened strand rope and locked coil rope is better able to withstand crushing than a round strand rope. The core should be of steel wire.

③ Describe a typical arrangement of cage and guide rope used in mines.

OR

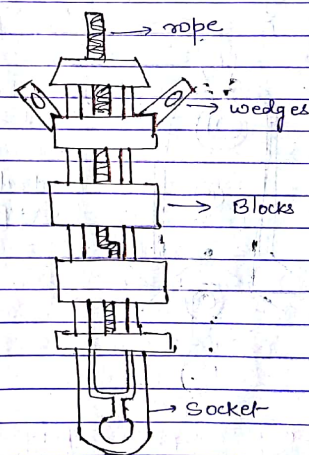
④ Describe with a neat sketch how the winding rope is connected to the cage, including all appliances and attachments between the rope and the cage in case of winding system.

OR

2 (b) Draw and explain suspension gear arrangement used for Keeper ~~drum~~ ^{drum} winders.

(1) Rope Capel

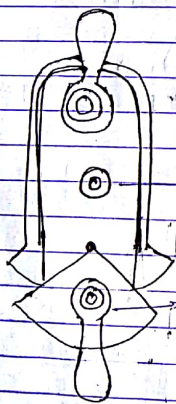
The rope capel is of the Reliance type consisting cast steel, interlocking wedges and conical blocks fitted filled with white metal. There is wrought iron housing with five hoops. It must be renewed once in every 6 months & length of rope cut off both to facilitate internal examination & to remove the part of the rope nearest to capel where it is most liable to fatigue.



Reliance Capel.

(2) Detaching hook or Safety hook

The detaching hook is of King type which consist wrought iron plate, main bolt or central fitted of wrought iron & auxiliary copper rivet (pin). It is most important safety device which is used in case of over winding. When over winding takes place, bottom part of the hook pressed inside by detaching bell and the rope is released. The cage is suspended to headgear. The detaching hook must be refitted atleast once in every 3 months.

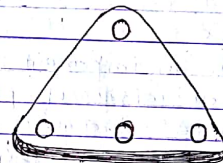


central or main bolt
Copper pin

King Type Safety hook

(3) The triangular distribution plate

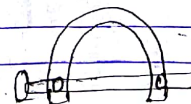
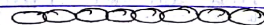
It is of wrought iron, or mild steel and provided with four holes for the chain cycle. The total load is equally distributed by this triangular plate. Four chains are attached to the triangular plate. Under the mining reg. all chains are connected. annealed atleast once in every 6 months.



(4) Cage chain & Bull chain

All the chain & D-links as well as bolts are made of wrought iron or mild steel. All chain must be annealed atleast once in every 6 months.

All parts must be given a careful daily examination to see that they are safe in all respect.



- ③ What are the different types of steel wire ropes used in mining? Describe them and give their uses. What are the common causes of rope deterioration.

OR

- ③ Distinguish b/w round strand, flattened strand and lock-coil ropes? Write their typical uses.

Ans Wire Rope

A wire rope is an important item in mining. It is made of steel wires of plain carbon having high tensile strength.

It is a combination of steel wires arranged around the central wire known as Core. Wires are twisted around a wire or fibre's centre to form a 'strand'. These strands are further twisted around a central core to form a "wire rope".

→ Types of Steel wire Ropes

Rope is classified on the basis of -

(1) Use of rope

(a) Running rope

The rope which have to undergo frequent movement, running or coiling often with varying loading are called running rope.

Ex - Winding rope, haulage rope, CCM, Shovel, Crane, etc..

(b) Stationary Rope

The rope which require to carry the load but are more or less stationary are called stationary rope.

Ex - Guide rope in shaft, Overhead trolley wire rope.

(2) Construction of wire rope

On the basis of construction ropes are classified as -

(a) Stranded rope

(b) Non-Stranded rope

(a) Stranded rope

This rope is built of strands and each strand consists of a no. of concentrically twisted wires laid in the form of a helix around a central steel wire known as core.

Stranded ropes are further divided into two groups -

- (1) Round stranded rope.
- (2) Flat Flattened stranded rope.

⇒ Round Stranded rope

The common practice for round stranded rope is to be built up starting with one central wire covered concentrically with successive layers. The round stranded rope may be single stranded rope or multi-stranded rope. A single core wire covered by six wires gives a seven wire strand rope used in haulage rope. If the construction is again covered with a second layer with 12 wires, it is called 19 wire stranded rope.



7 wire rope



19 wire rope

⇒ Advantage

- (i) Ability to withstand without permanent deformation.
- (ii) It returns to its original position when load is removed.

⇒ Disadvantages

- (i) Compared to flattened rope they are less flexible.
- (ii) They have less strength.

⇒ Use

→ Flattened stranded rope

There is a little bit confusion b/w flattened rope and flat rope. In flat rope the strand have a core of triangular cross-section whereas in flattened rope several strands are stitched side by side mild steel wires.

In comparison to round stranded rope, it is more flexible but its life is shorter. It is mostly used in Koepe winding.

⇒ Advantages

- ① They are more flexible.
- ② They have been preferred as balancing rope on the Koepe system of winding.

⇒ Disadvantages

- ① Their life is much shorter as compared to round stranded rope.

Use

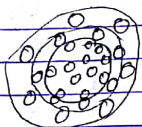
(b) Non-Stranded Rope (Locked-Coil Rope)

Non-stranded rope wire rope is also referred as locked coil rope. The rope have smooth outer surface and its central portion consist of the thick round wire placed b/w special shaped wires of I-section, rail-section, trapezoidal section. So that the wire locked with one another. The outer wire of this rope are laid in opposite direction of the inner wires. This is mostly used in shaft sinking where guide rope are not used. This is stronger and heavier than stranded rope but has less flexibility. The rope can not be lubricated from outside.

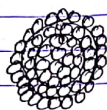


Type

- (i) Half coiled rope (ii) Full coiled rope



Half locked coil



Full locked coil

Advantages

- (i) It has a major advantage in sinking shaft where guide ropes are not available.
- (ii) For winding & hoisting purposes a locked coil rope is sometimes preferred.
- (iii) It has capacity high factor of safety.

Disadvantages

- (i) Construction is somewhat difficult.
- (ii) Its interior cannot be lubricated from outside.
- (iii) It is not so flexible.
- (iv) They are not preferred in rope winders because of smooth surface and low coefficient of friction.

Uses

Factor of Safety

It is the ratio between maximum breaking strength of the rope and the load applied to it.

$$F.O.S = \frac{\text{Maxm Breaking Strength}}{\text{load applied}}$$

$$F.O.S = \frac{S \times N}{W}$$

where S = Breaking strength of rope

N = No. of round of wire moving

W = Static load applied.

Causes of

→ Deterioration of the wire rope
The following are the types of deterioration of wire rope -

(1) Wear

The wire ropes are liable to external and internal wear. The internal wear is quite small is caused due to wire bending. The external wear is due to friction of rope with drum, pulley, etc.

(2) Corrosion

It is caused due to atmospheric condition, moisture & coal dust as well as chemical fumes. Adequate lubricant and galvanised wires will minimise this cause.

(3) Fatigue

It is caused due to repeated bending and applying of stress on the wire.

(4) Surface embrittlement

Sudden increase in temp about 700°C due to friction & cooling of rope cause rope brittleness. This is more common in haulage rope.

(5) Laziness

This occurs in locked coil rope generally and not considered dangerous until the inside wires get affected. The wave produced travels through the length and accumulates at the capel may forced to lock and form a bind.

2016

Q. Give a list of safety devices and their purposes that are used on a winding system.

Ans. The safety devices used for a winding system are the following -

(1) Mechanical brake or frictional brake

It is used along to stop or decreasing speed mechanically. A lever or clutch is provided for applying this brake.

(2) Advanced mechanical brake

It is acting on the brake rim of the coupling b/w the motor and the gear box. It brings the immediate stop.

The motor brake operates synchronously with the mechanical brake.

(3) Automatic Contrivance

It prevents over-speeding and overwinding.
It ensures slow banking at a speed of 0.5 m/s .

(4) Reverse direction prevention switch

It is used to trip power if the winding engine through mistake operates the motor in wrong direction.

(5) Time limit switch

It is mounted on the headgear at the pit top which is used to trip electric p. supply to the motor if ascending cage overshoots the decking level. The cage strikes a lever which operates this switch. Sometimes this switch also provided for the down going cage.

(6) Rope deviation limit switch

It is used in multi rope koepe winder. If any one of the ropes deviates from its normal path, it strikes a small pulley which actuates the arrangement for tripping power to motor.

(7) Limit switch

If the tail rope is reduced for any reason or if the loop is obstructed for any reason, then limit switch trip the power.

(8) Tachometer generator on the gear box

If the gear box is faulty and the winding drum shaft does not run at its normal speed, the tachometer generator will not generate sufficient direct current. This shortfall in the direct current results in tripping in power to motor.

(9) Wedge arresters

It is used to arrest down going cage.

(10) Safety Catches

It is mounted on the header which is used to arrest the cage in case of falling due to overwinding.

(11) Safety detaching hook

It is used to detach the rope in case of overwinding.

(12) Depth indicator

(13) Speed indicator

⑦ Compare drum winding with Koepe winding

	<u>Drum</u>	<u>Koepe</u>
1. Arrangement	Drum	pulley
2. Space	more	less
3. power cons.	more	less
4. production	less	more
5. Rope expansion	less	more
6. Motor power	Big	Small
7. Avoid Overwinding	May be	Not possible
8. Maintenance Cost	more	less
9. Factor of Safety	more than 10	less than 10
10. Stop sinking	No	Yes
11. If rope breaks	only one cage fall	both
12. chances of accident	less	more

2015

⑧ What are the various type of Capel for steel wire winding rope. Describe one in detail

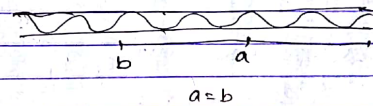
Rope Capping

The process by which the end of the rope is made suitable for attaching the load to it. The rope end is made suitable should be clean and free from rust, worn bend.

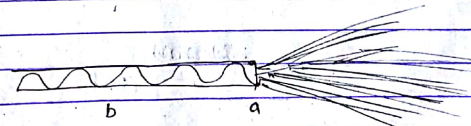
There are 3 types of rope Capel —

(1) Split Capel with rivets

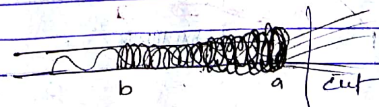
Step I



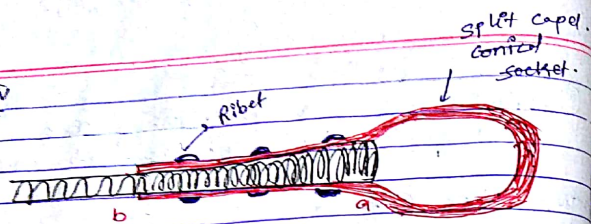
Step II



Step III



Step IV

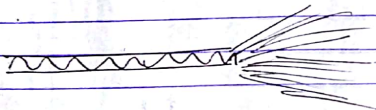


(2) Coned - Socket type Capel

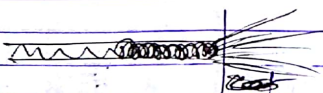
Step I



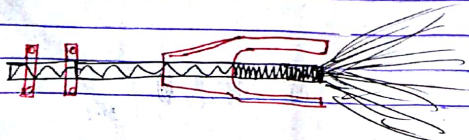
Step II



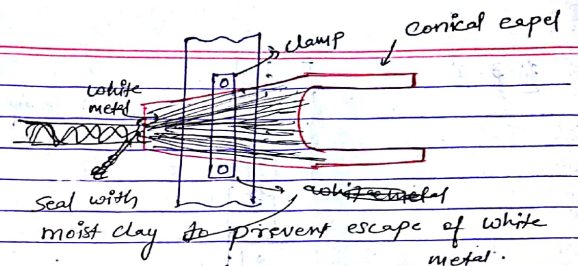
Step III



Step IV

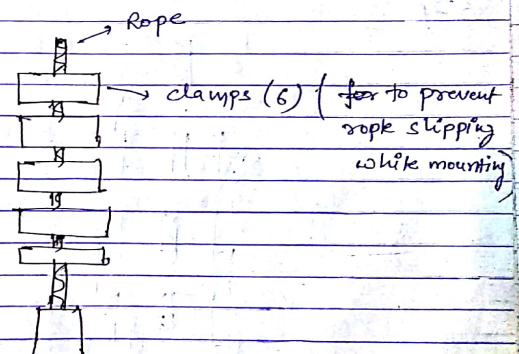


Step V

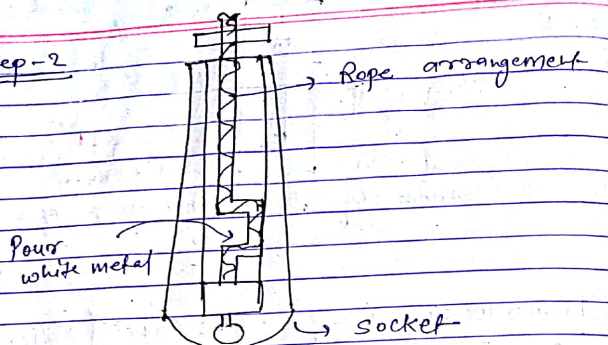


(3) Interlocking wedge type Capel (Reliance Capel)

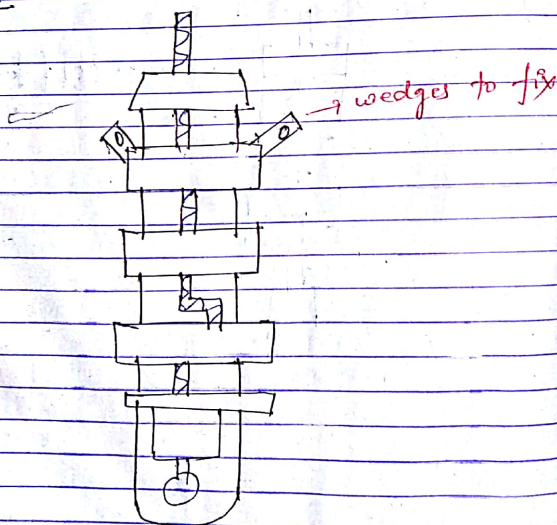
Step I



Step-2



Step 3



Read mine digest Pg no- 334 (Tuition Copy)

⑤ What type of pumps used in mine? Describe any one type of face pumps?

OR

④(a) What are the various types of pumps commonly used in mines? Give their classification.

OR

④(b) Write short notes on water hammer

OR

Ans. → Water Hammering

This is a violent shock caused by a moving column of water being suddenly brought to rest. In reciprocating pumps, it is liable to occur whenever the Ram or piston returns into a half empty casing.

Reason

- (i) the suction pipe is small or choked.
- (ii) A valve being defective
- (iii) a valve seat loose.

Water hammer may cause to blow out a joint or damage some part of the pump, delivery column.

Precaution

- (i) A large diameter suction range should be used.
- (ii) Suction range should be checked for chocking.
- (iii) Valves and Valve seats should be checked.
- (iv) The suction range be shorter.
- (v) Air vessels should be used.
- (vi) Ram should be kept to such a Valve that it moves with water in synchronism.

→ Classification of mine pumps - The

⇒ Types of pumps used in mines
Following the various types of pumps commonly used in mines -

- (1) Reciprocating pump
- (2) Centrifugal pump
- (3) Turbine pump
- (4) Face pump

→ Face pump

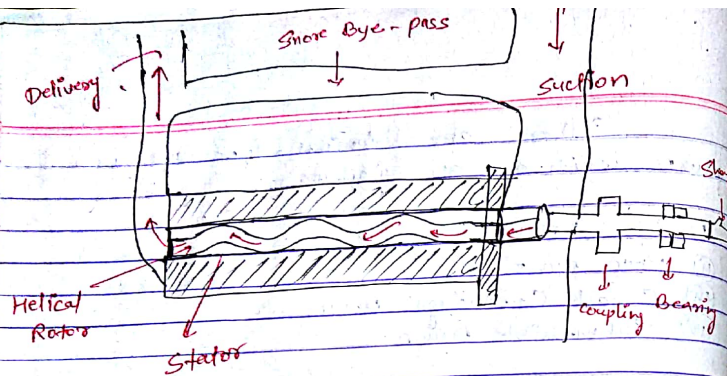
Face pump is a type of pump which are used to keep the face clear off water so that the face is always kept dry and can be worked.

There are various types of face pumps which are as follows -

- (i) Mono pump
- (ii) Roto pump
- (iii) Small Centrifugal pump
- (iv) Submersible pump.

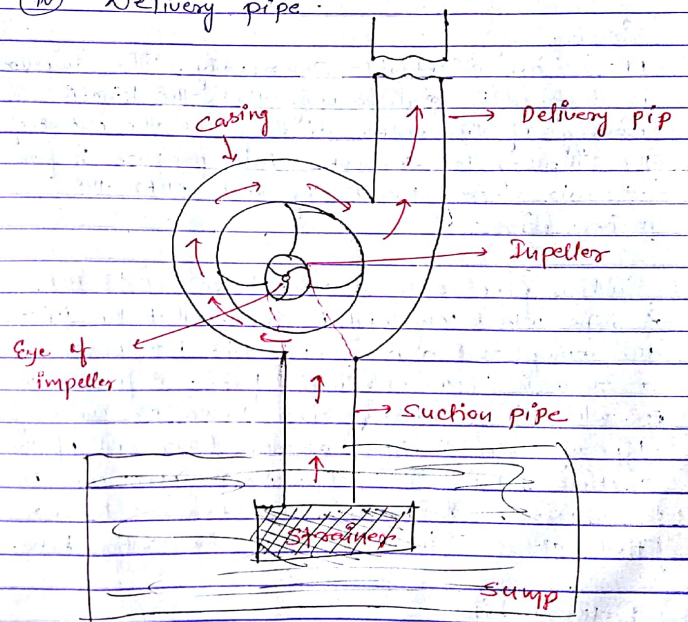
→ Mono pump

Mono pump (Roto pump) is used for dewatering the running face so it is also known as face pump. The ~~mono pump~~ Roto Company manufactures the mono pump. So it is mostly called Roto pump. This pump consists of single helical steel rotor placed within a rubber stator. The radial cross-section of the rotor is given motion through the hollow shaft by the coupling rod suction and delivery branches, are within the main structure of the pump being connected by a ^{snore} ~~short~~ bye pass. The use of snore bye pass is to recirculate the an small quantity of water through the pump; so the pump works on air. It keeps the rotor & stator lubricated. The pump is self priming. It gives a uniform performance & can work in a muddy water having suction lift as high as 25m.



→ Main parts of Centrifugal pump

- (i) Impeller
- (ii) Casing
- (iii) Suction pipe with a foot valve and strainer
- (iv) Delivery pipe



(2) Describe Construction and action of a single stage Centrifugal pump.

Ans Centrifugal pump

The hydraulic machines which convert the mechanical energy into hydraulic energy are called pump.

The hydraulic energy is in the form of pressure energy. if the mechanical energy is converted into pressure energy by means of centrifugal force acting on the fluid; the hydraulic machine is called Centrifugal pump.

(1) Impeller

The rotating part of the centrifugal pump is called impeller. It consists of a series of backward curved vanes. The impeller is mounted on the shaft which is connected to the shaft of an electric motor.

(2) Casing

It is an air-tight surrounding. The impeller is designed in such a way that the kinetic energy of the water discharge at the outlet of the impeller is converted into pressure before the water leaves the casing and enters the delivery pipe.

(3) Suction pipe with a foot Valve & Strainer

A pipe whose one end is connected to the inlet of the pump and another end dips into water in a sump is known as suction pipe. A foot Valve is which is a non-retainer valve or one way type of valve is fitted at the lower end of the suction pipe. The foot Valve opens only in the upward direction. A strainer is also fitted at the lower end of the suction pipe.

(4) Delivery pipe

A pipe whose one end is connected to the outlet of the pump and other end delivers the water at a required height is known as Delivery pipe.

⇒ Principle action of Centrifugal pump

The centrifugal pump acts as a reverse of an inward radial flow reaction turbine.

This means that flow reaction in centrifugal pump is in radial outward direction.

The centrifugal pump works on the principle of forced vortex flow which means that when a certain mass of the liquid is rotated by an external torque the rise in pressure head at any point of the rotating liquid takes place and the rise head pressure at any point of the rotating liquid is proportional to the square of tangential velocity of the liquid at that point.

$$\text{i.e. Rise in pressure head} = \frac{v^2}{2g}$$

$$\text{or } \frac{\omega^2 r^2}{2g} \quad [\because v = \omega r]$$

(10) What is Continuous Miner? Write its advantages and disadvantages.

Ans. Continuous Miner is a latest type of machine introduced in coal industry. JOY of UK is the first manufacturer and introduced this machine.

This machine is operated in B & P district where seam thickness may be 4.5 m - 6 m, width of gallery may be 4.8 m - 6 m. Gradient 1 in 6 or flatter.

Description

This machine is a crawler mounted. It has got strong chassis on which the machine parts are available.

The main parts of the machine —

- (a) A cutting boom which can move in horizontal and vertical direction, mounted on a suitable bearing on the machine.
- (b) The cutting head mounted on the free end of the boom and provided with sufficient no.

of cutting bits. The bits are made of tungsten Carbide about 1/2 kg in weight.

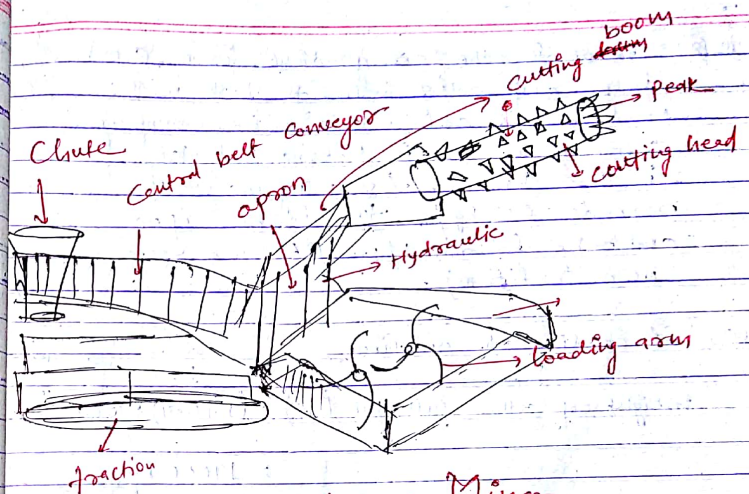
- (c) The apron is of adequately strong steel plates kept at incline position upto the toe level of the face. The cut coal to fall over it.
- (d) The loading arm. These are two in numbers having oscillatory movement pushing coal to the central chain conveyor.
- (e) The Central Chain Conveyor. This moves at the central part of the apron. The upper part of the chain is in rising mode. Therefore it can carry the coal upwards.
- (f) At the top of the machine there is a chute through which coal drops on the carrier of the Shuttle car.
- (g) As the cutting goes on, the machine advances and the process continues.

→ Advantages

- (i) High production and productivity
- (ii) less manpower
- (iii) No blasting required
- (iv) It can be used in development as well as depillaring also
- (v) It can cut soft and hard coal both if continuous miner is of high capacity

→ Disadvantages

- (i) Generally not able to cut full face in one pass
- (ii) Mismatch of Shuttle Car and Continuous miner during cutting and loading in big size pillar
- (iii) Slow movement of Shuttle Car or long path of Shuttle Car can idle and
- (iv) Continuous miner of big capacity of cutting machine can block face ventilation
- (v) Gallery of less width is not permitted to the car for operating



Continuous Miner

18
 Ques 2) What is the least gradient for a 600m long self acting incline to work with 10 tubs on each train? The carrying capacity of tub is 1 tonne and time is 0.2 min. Assuming weight of rope is 1.5 kg/m, tub friction 1/50 and rope friction 1/10. (Assume your own conditions).

Soln According to question,

$$\begin{array}{l} \text{Weight of the full tub (W)} = (1 + 0.4) \times 1000 \times 10 \\ = 14000 \text{ kg} \end{array}$$

$$\begin{array}{l} \text{Weight of empty tub (W}_1\text{)} = \frac{0.6 \times 1000 \times 10}{10} \\ = 6000 \text{ kg} \end{array}$$

$$\begin{array}{l} \text{Weight of the rope} = 600 \times \frac{1.5}{10} \\ = 900 \text{ kg} \end{array}$$

$$\begin{array}{l} \therefore \text{Frictional resistance of full tubs (f)} \\ = 1 \times W \\ = \frac{1}{50} \times 14000 \\ = 280 \text{ kg} \end{array}$$

$$\begin{array}{l} \text{Frictional resistance of empty tubs (f}_1\text{)} = 1 \times W_1 \\ = \frac{1}{50} \times 6000 \\ = 120 \end{array}$$

$$\begin{array}{l} \text{Frictional resistance of rope (f}_2\text{)} = 1 \times W_2 \\ = \frac{1}{10} \times 900 \\ = 90 \end{array}$$

$\therefore$ Least gradient for self acting incline

$$= \frac{F + F_1 + F_2}{W - W_1 - W_2}$$

$$= \frac{280 + 120 + 90}{14000 - 6000 - 900}$$

$$= \frac{490}{7100} = \frac{1}{20.22}$$

1 in 20.22

Ans